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SELECTION OF THE OPTIMUM GEOTECHNICAL PROTECTIVE MEASURES ON SLOPE OF ROAD CUTING

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ABSTRACT
The problems of loss of the rock mass, and in general the soil, the road cutting are usually handled using protective measures. Successful solving of this problem depends on the choice of the optimal solution.
Selection of optimal solution can be obtained after a detailed analysis of the condition on the slope cutting. These conditions consist of a set of relevant factors, with smaller or larger degree of influence on the current instability and the instability that occurs over time.
The paper presents the methodological principles of analysis and selection of the optimal solution of geotechnical protection on slope of road cutting.
Keywords: Methodology, Slope of Road Cutting, Slope Protection, Categories of Condition, Optimal Solution.

1. INTRODUCTION
One of the more salient of geotechnical problems, especially in the exploitation phase of the road, is providing the stability of slopes on parts of the cuttings and cuttings, embankments, and then landslides on slopes that are located on a route of the designed and used road.
Slope stability can be achieved using various geotechnical measures to protect and repair, which depends on the type and intensity of the processes that affect the instability, as well as the phase of the concrete case of instability.
Selection of the optimal solution to this geotechnical problem with roads requires the examination of the link between conditions and the factors that cause slope instability phenomenon, defining its character and uniqueness, and selected remedial or protective geotechnical measures.
A significant problem lies in the understanding of the basic and, conditionally speaking, key postulates that allow the correct approach to solving the geotechnical problems of road cuting. The proper approach implies a clear distinction between:

- Slope protection,
- Protection of roads.

Slope protection, in general terms, is the application of geotechnical protection measures that prevent the formation or development of existing engineering and geological processes that create conditions for the emergence of some of the aspects of slope instability on the road.

2. PRINCIPLES OF ASSESSMENT OF CONDITIONS PREVAILING ON THE SLOPE
Hazard of mass loss on the slopes of cuttings or cuttings of roads lies in the functional dependence on the environmental conditions on the slope. Therefore, in some cases, this hazard is obvious, while in some cases the hazard of this type is completely hidden. This fact indicates the need for systematic analysis and evaluation of conditions at and around the curve slope.

A systematic approach to the assessment of conditions implies the existence of so-called hazard rating system or classification schemes. These schemes include specific categories, whose individual assessment are defined by the overall result, which defines the slope with respect to the hazard of the loss of mass.

Figure 1. The inefficiency of measures of protection on the slopes (Photo: A. Ibrahimović, 2010/2011)

Rating conditions at slope road cuttings or cuttings is possible through analysis of relevant categories which affect the development of instability, regardless of the form of instability. After the analysis, each of these categories has its own rank or rating, which describes the benefits but also the assessment of the importance of this category for the overall assessment of conditions at the slope. The sum of all rating categories makes up the final hazard assessment of mass loss from the slope and defines the most likely manifestations of these losses.

3. CATEGORIES THAT DEFINE CONDITIONS ON SLOPES

Based on experience and on the basis of preparations done for the realization of the aforementioned scientific research project, the following categories are defined that would make up the classification scheme, and based on their analysis an assessment of conditions prevailing on the slopes of cuttings and cuttings for roads would be given:

- Geometrical and orientational characteristics of the slope,
- Hydrogeological characteristics on the slope,
- Engineering geological characteristics,
- Vegetation characteristics,
- Climatic conditions,
- Spatial relationship the slope with the road,
- Locality of slope and relationship with other buildings,
- Traffic characteristics.

A very important fact in this methodological approach is the monitoring of slope before selecting the type of protection that will be performed on the slope, but also after the performance. Monitoring prior to the selection of the method of slope protection produces the necessary information about the frequency of modern engineering and geological processes and their magnitude. These data are an integral part of the overall engineering and geological features. Monitoring the safety measures implemented allows the evaluation of the performance of these protective measures (*Figure 2.*).

Therefore, assessment of conditions and the choice of the optimal solution for geotechnical safety measures on road slope is not a process at a particular moment but over a period of time, i.e. it is a function of time.

Figure 2. Monitoring of slope in the function of selection of the optimal geotechnical protective measures (Photo: A. Ibrahimović, 2010/2011)

4. SELECTION OF PROTECTIVE MEASURES ON SLOPE OF ROAD CUTTING

Approaches to solving these problems are very different and they are largely dependent on the level of general socio-economic development, or on the possibilities available to the community in which these problems occur. Under the first approach, which is more comprehensive, the range of protective measures on the slope rests on two pillars. Another approach, one that should be applied here due to objective reasons, relies on a single column. This column, in order to achieve sustainable quality choice of geotechnical protection measures, should be expanded, exactly through a detailed assessment of conditions on the slope cuts and road cuts, under the adopted classification scheme.

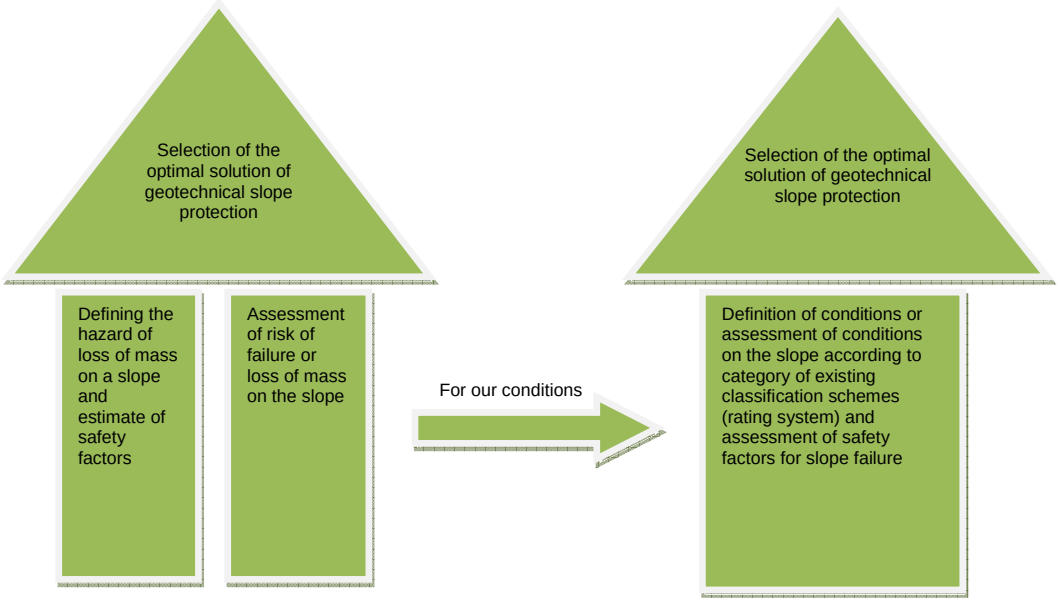

Figure 4. Scheme of relationships between concepts to solve the problem of instability by applying geotechnical protection measures (Scheme: A. Ibrahimović, 2011.)

Based on the above reasoning, the optimal solutions to protect slopes of cuttings and cuttings for roads can be summarized in the following functional dependencies:

The optimal solution to protect the slope = f (Slope stability) = g (Categories of assessment of conditions on the slope)

Decision on taking protective measures on the slopes implies a clear idea of two facts:

- Defining ways and the degree of weight loss with a slope, or the environment in which this process takes place,
- Defining an acceptable degree of instability.

This intermediate step is also important and it complements this methodological approach, and can be seen, conditionally speaking, as a kind of substitute for the lack of procedures for risk assessment and determination of acceptable risk.

Therefore, the selection and performance of geotechnical measures to protect the slopes of cuttings and cuttings on roads can be viewed as a three-phase process, which is, at least in our conditions, defined by:

- Circumstances,
- Requirements,
- Opportunities.

Alignment of these phases of of the single stage process leads to the selection of the optimal solution for geotechnical safeguard.

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